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# Revision of some *Peziza* collections in herb. TAAM (Tartu)

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Abstract—Forty samples representing the genus *Peziza* kept in the Mycological Herbarium, Tartu, Estonia (TAAM) were studied. Collection data and taxonomic comments are presented.

Key words—*Ascomycota*, *Pezizales*, *Pezizaceae*

## Introduction

This work, part of a series of papers concerning the revision of specimens assigned to the genus *Peziza* Dill. ex Fr. kept in various herbaria, is intended to confirm their importance for the studies on mycological diversity and taxonomy.

Forty samples, initially labelled under various names and located in the Mycological Herbarium, Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences, Tartu, Estonia (TAAM) (founded in 1950 at the Institute of Biology of the Estonian SSR Academy of Sciences; Parmasto 2011), were studied. Our examinations revealed that not all specimens were originally correctly determined; various specimens were shown to correspond to different species, while others could not be definitely identified. Some of these samples have also been used to carry out molecular analyses, the results of which have been published in previous papers (Medardi et al. 2012, Medardi et al. 2014).

## Materials & methods

Morphological and microscopical examinations were carried out on Dried specimens were rehydrated in water or KOH 5% and mounted in water with lactic blue to highlight spore ornamentation and/or with Melzer's reagent to observe the iodine reaction of the asci. The tissues were examined microscopically with an Optika BK 1301 optical microscope with 40× or 100× (oil immersion) objectives; dimensions were determined from 50 mature spores per collection.

## Results

***Peziza alcis*** Harmaja, Karstenia 26(2): 44. 1986.

> Material examined: **ESTONIA: Jôgevamaa Co**, Kursi, Puurmani Commune, Altnurga, Forestry sq. 95, on moose dung, 8.10.1997, leg. et det. M. Öpik (TAAM 171114, as *P. fimeti*); **Rägavere Comm.**, Uljaste, Lääne-Viru Co., on ground and on dung, in moist *Betula–Picea* forest, s.d., leg. K. Kalamees, det. A. Raitviir (TAAM 71260, as *P. fimeti*). **FINLAND: Lapland**, Kevo, National Park, on moose dung, 28.08.1981, leg. K. Kalamees, det. A. Raitviir (TAAM 122042, as *P. fimeti*).

Notes: These materials, labeled in the herbarium as *P. fimeti,* have been redetermined as *P. alcis*. The spores were smooth and averaged 15–17(–18) × (7–)7.5–9 µm; the excipulum comprised only one layer (textura globulosa or globulosa-angularis), differentiable into one subhymenium, one medullar excipulum and one ectal excipulum by the cell sizes consistently wider towards the outside of the apothecium. Molecular analysis of TAAM 171114 also confirmed identification of *P. alcis* (Medardi et al. 2012).

TAAM 122042 was judged not to be completely mature, based on the numerous spores still contained in the asci. *Sporormiella australis* (Speg.) S.I. Ahmed & Cain was also noted on the dung.

***Peziza arvernensis*** Roze & Boud., Bull. Soc. Bot. Fr. 26 (Suppl.): LXXVI. 1879.

> Material examined: **DENMARK: Zealand**, Grib Skov, on ground among stones, 14.08.1965, leg. P. Milan Petersen, det. H. Dissing (TAAM 187941); **ESTONIA: Tartu Co.**, along the road toward Tallinn, in a *Populus* forest, 13.05.2007, leg. L. Tedersoo, det. K. Hansen (TAAM 192338).

Notes: The spores measured (16–)17–20 × (8–)9–10.5 µm and were ornamented with manifest punctiform warts. A section showed the typical tissues of *P. arvernensis:* subhymenium of textura globulosa-angularis, the medullar excipulum comprising three layers (the upper and lower layers a textura globulosa and the middle a textura intricata), and an ectal excipulum of textura intricata. The habitat of this species is rather variable; that reported for these two collections is within specifications.

***Peziza atrospora*** Fuckel, Fungi Rhenani Exsic.: no. 1224. 1864.

> Material examined: **ESTONIA: Tartu Co.**, Nõo Comm., Peedu, on ground, 26.07.2000, leg. et det. B. Kullman (TAAM 179346, as *P. pseudovesiculosa* Donadini).

Notes: TAAM 179346 comprises two specimens, both originally identified as representing *Peziza pseudovesiculosa*. Our redetermination of the species to *P. atrospora* is supported by spores measuring 17–18 × 7–9 µm, most with 1–2 oil drops and with elongated warts often connected in short crests ≤1 µm high. Other characters include a subhymenium of textura intricata, a medullar excipulum of textura globulosa-angularis with cells 60–80(–110) µm diam., and an ectal excipulum of textura globulosa-angularis.

***Peziza cinatica*** Pfister, Mycotaxon 8(1): 189. 1979.

Material examined: **ESTONIA**: **Harju Co.**, Viimsi Comm., Prangli Island, near Idaotsa Farm, on clay soil of a well in *Pinus* forest, 25.08.1960, leg. P. Põldmaa, (TAAM 028962, TAAM 028963, as *P. domiciliana* Cooke).

Notes: We redetermined this material, bearing the herbarium label *P. domiciliana*, to *P. cinatica*. The ascospores, which measured 11–13(–14) × (5–)6–7 µm and contained 2 oil droplets, were ornamented with fine punctiform warts ≤1 µm. The medullar excipulum is a textura intricata with brownish hyphae (ca. 5 µm diam.) often perpendicular to the hymenium, and the ectal excipulum is a textura globulosa, with some rounded (20–50 µm diam.) and elongated (20–40 × 15–25 µm) cells intermixed.

*Peziza cinatica* is not widely distributed but does not appear to be restricted to one habitat type. Previously reported substrates include ash (Pfister 1979) and burn residue (Dougoud 2001), but the above material (TAAM 028962, TAAM 028963) was collected on clay soil.

***Peziza fimeti*** (Fuckel) E.C. Hansen, Vidensk. Meddel. Naturhist. Foren. Kjøbenhavn 59: 267. 1877 ["1876"].

Material examined: **RUSSIA**: **Kamchatka**, 47 km from Krapivnaya, on dung of *Ursus ursus*, 6.08.1978, leg. B. Kullman (TAAM 187899, TAAM 187900); **Krasnodar**, Umpyr, Caucasus Nature Reserve, on dung, 10.08.1976, leg. M. Pallo, det. A. Raitviir (TAAM 064318); Malaya Laba, Caucasus Nature Reserve, on dung, 12.08.1976, leg. M. Pallo, det. A. Raitviir (TAAM 064369); **Kuril Islands**, Kunashir Island, Lagunnoye, on excrements, 12.08.1970, leg. B. Kullman (TAAM 061513); **Respublika Tyva**, Erzin, on dung, 18.07.1972, leg. B. Kullman (TAAM 065761). **TAJIKISTAN**. Ramit State Nature Reserve, Mount Hissar, on dung, 12.04.1977, leg. et det. A. Raitviir (TAAM 064569); **Hovaling**, on bovine excrement, 22. 04.1985, leg. B. Kullman, det.. A. Raitviir (TAAM 115898). **UZBEKISTAN**: Dshisaki, Turkestan Chain, Kulsai, Zaamini Nature Reserve, in *Juniperus* forest, 24.05.1980, leg. K. Kalamees, det. A. Raitviir (TAAM 199165).

Notes: Ascospores measuring (19–)20.5–22(–22.5) × (10–)11–12 µm and flesh composed of globose or globose-angulated cells differentiated into a subhymenium, a medullar excipulum (with some filamentous hyphae visible), and an ectal excipulum confirm *Peziza fimeti.*

Our molecular analyses (Medardi et al. 2012) of TAAM 187900 and TAAM 064318 also supported *Peziza fimeti*. *Sporormiella australis* was also found in TAAM 064318. TAAM 115898 is immature.

Noteworthy is the fact that the apothecia TAAM 187899 and TAAM 187900 were found (dung of *Ursus*), a previously unreported substrate.

***Peziza howsei*** Roze & Boud., Bull. Soc. Bot. Fr. 26 (Suppl.): LXXV. 1879.

Material examined: ESTONIA: **Hiiu Co.**, Hiiesaare Light House, on ground, 18/09/2001, leg L. Vaher, det. B. Kullman ([TAAM 179773, as *Pachyella celtica* (Boud.) Häffner); **Tartu Co.**, Võnnu Comm., Järvselja Forest [sq n. 226 (4)], on ground, 27.09.2001, leg. et det. B. Kullman (TAAM 179788).

Notes: Both samples were characterized by a subhymenium of textura intricata (hyphae 5–6 µm diam.), a 2-layered medullar excipulum (upper a textura globulosa-angularis with cells ≤25 µm diam.; lower a textura ± intricata toward the upper layer and tending to globulosa-angularis with cells similar to those of the upper layer), and an ectal excipulum of textura globulosa with cells 10–25 µm diam. Ascospores were 17.5–19.5(–22.5) × 8.5–9.5 µm, with fine punctiform warts (0.5–1 µm diam., ≤0.5 µm high), more or less isolated but occasionally joined to form short crests.

*Peziza howsei* is morphologically similar to *P. emileia* Cooke, but despite several overlapping characters, their different ITS sequences support them as two separate species (Medardi et al. 2014).

***Peziza lividula*** W. Phillips, in Cooke, Mycographia: 161. 1877.

Material examined: ESTONIA: **Pärnu Co.**, Koonga Comm., between Mihkli and Koonga, in *Picea* forest, 16.08.1960, leg. et det. A. Raitviir (TAAM 040951, as *P. howsei*); **Saare Co.**, Lümanda Comm., Koimia, on ground, 24.08.1960, leg. et det. A. Raitviir (TAAM 041035, as *P. howsei*); **Hiiu Co.**, Kärdia Comm., next to Kärdia, near the road to Käina, in *Corylus* forest, 4.09.1960, leg. et det. A. Raitviir (TAAM 041235, as *P. howsei*); **Lääne Co.**, Hanila Comm., Puhtulaid islet, near Virtsu, in a forest of mixed deciduous trees, 6.09.1960, leg. et det. A. Raitviir (TAAM 041243, as *P. howsei*); **Tartu Co.**, Võnnu Comm., Järvselja forest [sq n. 226 (4)], on ground, 27.09.2001, leg. et det. B. Kullman (TAA 179791, as *P. howsei*). RUSSIA: **Irkutskaya Oblast**, Ust-Kutskiy, Erlenga, along a path in a forest, 27.08.1967, leg. M.A. Bondarceva, det. A. Raitviir (TAAM 199080, as *P. howsei*).

Notes: In this group all samples were at first labelled *P. howsei*. We redetermined them to *P. lividula* based on the following characters: ascospores 15–19 × 8–10(–10.5) µm, each with 2 oil droplets and punctiform warts ± wide (1–1.5 µm diam.), at times more elongate and closed near the extremities where they resemble low skulls; a subhymenium of textura prismatica or prismatica-angularis.

***Peziza perparva*** Harmaja, Karstenia 26(2): 47. 1986.

Material examined: **RUSSIA**: **Sverdlovskaya Oblast**, Kytlym, on unidentified dung, 20.07.1973, leg. A. Raitviir (TAAM 062952, as *P. fimeti*).

Notes: We redetermined TAAM 062952 (labeled as *P. fimeti*) to *P. perparva*. The ascospores measured (11–)12–13 × 6–7 µm and were ornamented with a weak ±open reticulum; the tissues were arranged differently than those found in *P. fimeti:* subhymenium of textura intricata mixed with a few globose cells, medullar excipulum of textura globulosa or globulosa-angularis, and ectal excipulum with a structure similar to that of the medullar layer but with smaller cells. Also diagnostic of *P. perparva* are the very small apothecia, only 1–3 mm diam.

TAAM 062952, which represents just the second collection of *P. perparva* in Europe (the type collected in Finland and published by Harmaja 1986), expands the range and habitat of this remarkable fungus. Harmaja (1986) stated that *P. perparva* fruits "in moist place on a forest path used by elks, growing in dead plant litter apparently earlier impregnated by elk urine . . ." The Russian specimens appear to grow instead on rodent dung (showing that the fungus is not restricted to elk) at a lower latitude (Lantieri et al. 2011).

*Sporormiella australis* was also identified on some of the dung associated with the Russian collection.

***Peziza varia*** (Hedw.) Alb. & Schwein. Consp. Fung. Lusat.: 311. 1805.

Material examined: **ESTONIA**: **Tartu Co.**, Tartu Comm., 57 Võru Street, along the border of a woody floor in a cottage, 12.09.1962, leg. et det. A. Raitviir (TAAM 043232, as *P. domiciliana*); near a cement base, 19.12.1977, leg. et det. B. Kullman (TAAM 199053, as *P. domiciliana*); 27-632 Narva Street, on a plastered block of a construction, 20.06.1994, leg. V. Kastanje, det. A. Jakobson (TAAM 199058, as *P. domiciliana*); **Viljandi Co.**, Kolga-Jaani Comm., Potaste, Vaibla Forest [sq n. 29], Pedja Natural Reserve, on ground, 11.09.1997, leg. et det. B. Kullman (TAAM 157677, 2 collections, as *P. arvernensis*). **RUSSIA**: **Kamchatka**, 47 km from Krapivnaya, on dung of *Ursus ursus*, 6.08.1978, leg. B. Kullman (TAAM 116381, as *P. fimeti*); **Yamalo-Nenetskiy Avtonomnyy Okrug**, Ovgort, on dung of *Ursus ursus* and ground around, 28.08.1976, leg. Murdvee (TAAM 110066, as *P. fimeti*).

Notes: We redetermined the original identifications of TAAM 116381 and TAAM 110066 (*P. fimeti*); TAAM 157677 (*P. arvernensis,* both specimens); and TAAM 043232, TAAM 199053, and TAAM 199058 (*P. domiciliana*) to *Peziza varia*. We detected a faint superficial roughness on the spores, which measured (14.5–)15–16 × (7–)7.5–8.5(–9) µm (smaller than those of *P. fimeti* at 20–22.5 × 10–12 µm), and the medullar excipulum showed a median, more or less thin layer of textura intricata, typical of *P. varia*.

Our study of TAAM 116381 and TAAM 110066 revealed that *P. varia* is also able to grow on dung, solving the long-standing question regarding two conflicting interpretations given in *P. fimeti* literature (Medardi et al. 2012).

The excipular structure of *P. varia* overlaps with that of *P. arvernensis* and *P. domiciliana*, which differ from *P. varia* in their larger spores with more or less evident punctiform warts (*P. arvernensis*, 16–19(–20) × 9–10(–11) µm; *P. domiciliana*, 15–17(–20) × 7–9(–10) µm, with occasional warts). The builder's rubble habitat of TAAM 043232, TAAM 199053, and TAAM 199058 belongs to the large assortment of substrata on which *P. varia* is able to fruit (Medardi et al. 2012).

### *Peziza* cf. *ampliata*

MATERIAL EXAMINED: **RUSSIA: CHELYABINSKAYA OBLAST**, Miass, on unidentified dung, 16.08.1973, leg. I. Parmasto (TAAM 062922, as *P. fimeti*).

NOTES: TAAM 062922, bearing the herbarium label of *P. fimeti,* was redetermined as *P.* cf. *ampliata*. This specimen was previously studied by Hansen et al. (2002). Our molecular analyses group it with *P. ampliata* Pers. (Medardi et al. 2012), although its macro- and microscopic features correspond to those of *P. fimeti:* ascospores measuring 18–20.5(–21) × (8.5–)9–11(–11.5) µm and a medullar excipulum comprising large, globose-angulated cells mixed with filamentous hyphae.

### *Peziza* cf. *fimeti*

MATERIAL EXAMINED: **ESTONIA: JÕGEVA CO.**, Puurmani Comm., Alam-Pedja Nature Reserve, on beaver dung, 21.08.1997, leg. A. Kollom, det. A. Raitviir, (TAAM 128087, as *P. fimeti*).

NOTES: This material, labeled as *P. fimeti,* is the "*Peziza* sp. h" analyzed by Hansen et al. (2002), who stated it is phylogenetically different from *P. alcis*, despite its similar microscopic characters: smooth ascospores 15.5–17 × (7–) 8–9(–9.5) µm and an excipulum consisting of practically only one tissue of (textura globulosa or globulosa-angularis), with three layers differing only in the cell dimensions.

### *Peziza* sp.

MATERIAL EXAMINED: **ESTONIA: PÄRNU CO.**, Koonga Comm., Mihkli Oaks, on ground in oak forest, 16.08.1960, leg. et det. A. Raitviir (TAAM 040944, as *P. howsei*); **SAARE CO.**, Part of "N" Reserve, Viidumäe Natural Reserve, in *Corylus* forest, 26.08.1960, leg. et det. A. Raitviir (TAAM 041077, as *P. howsei*); **LÄÄNE CO.**, Vormsi Comm., Huitbergi, on ground near fir roots, 22.10.2010, leg. et det. B. Kullman (TAAM 190485, as *Pachyella celtica*). **RUSSIA: RESPUBLIKA TYVA**, Kyzyl, Mazaloek, on ground, 4.08.1972, leg. A. Raitviir, det. B. Kullman (TAAM 065930, as *Pachyella celtica*); **KRASNODARSKIY KRAY**, Guzeripl, on ground, 25.05.1975, Leg. et det. A. Raitviir (TAAM 063473, as *P. howsei*); **Kamchatka**, 47 km from Krapivnaya, on dung of *Ursus ursus*, 6.08.1978, leg. B. Kullman (TAAM 187898, as *P. fimeti*).

Notes: Our examinations of these samples did not provide sufficient data for a sure identification, mainly due to the scarcity or lack of needed characters.

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## Literature cited

Dougoud R. 2001. Clé des Discomycètes carbonicoles. Documents Mycologiques 30(120): 15–29.

Hansen K, Læssøe T, Pfister DH. 2002. Phylogenetic diversity in the core group of *Peziza* inferred from ITS sequences and morphology. Mycological Research 106(8): 879–902. http://dx.doi.org/10.1017/S0953756202006287.

Harmaja H. 1986. Studies on the *Pezizales*. Karstenia 26(2): 41-48.

Lantieri A, Cacialli G, Medardi G. 2011. *Peziza perparva*, seconda segnalazione europea, individuata dallo studio di una raccolta russa. Rivista di Micologia 54(4): 307–313.

Medardi G, Lantieri A, Pfister DH, LoBuglio K, Cacialli G. 2012. Clarification of *Peziza fimeti* with notes on *P. varia* collections on dung. Mycotaxon 121: 465-476. http://dx.doi.org/10.5248/121.465.

Medardi G, LoBuglio K, Pfister DH, Lantieri A. 2014. Morphological and molecular study of *Peziza emileia* and *P. howsei*, two distinct taxa. Mycological Progress 13: 1227–1234. http://dx.doi.org/10.1007/s11557-014-1013-z

Parmasto E. 2011. Fungal herbarium EAA in Tartu (Estonia). Folia Cryptogamica Estonica 48: 69–72.

Pfister DH. 1979. Type studies in the genus *Peziza*. V. Species described by Rehm. Mycotaxon 8(1): 187–192.